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## (54) Method and apparatus for removing oil from articles.

(57) An apparatus for removing oil adhering to article (1) is provided with a sealed chamber (2), a vacuum pump (5), a gas feeding pipe (6), a radiant tube burner (4), a burner (8), an oil mist trap (16), and a condenser (7) if necessary. The oil adhering to the article (1) is evaporated and removed from the article (1) by being heated with the radiant tube burner (4) in replacer gas selected between non-oxidative gas and slightly oxidative gas, and the evaporated oil contained in the replacer gas is recovered by the condenser (7) or burned completely at the burner (8) together with burnable components contained in the replacer gas and impossible to be condensed by the condenser (7).

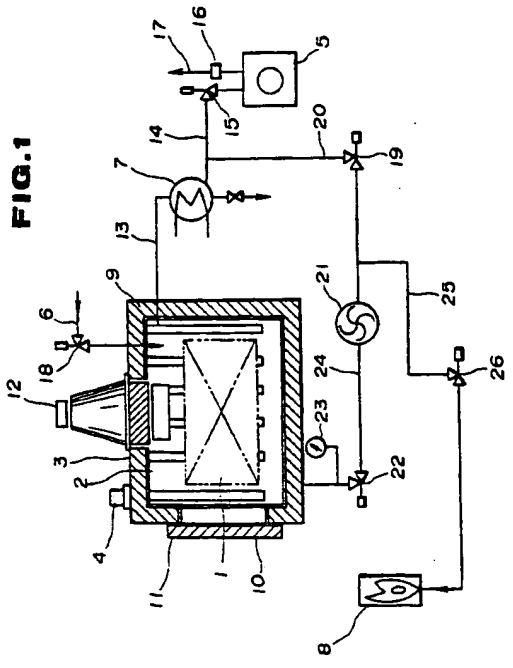

FIG.1

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This invention relates to a method and an apparatus suitable to remove oil adhering to the surface of articles and used for removing oils such as cutting oil, antitarnish oil (before quenching), quenching oil (after quenching) and the like sticking to the surface of, for example, machine parts and tools in a process of heat treatment of the machine parts and the tools.

Generally, in the heat treatment process of the machine parts, the tools and the like, the cutting oil, the antitarnish oil and so on adhering to the articles to be heat-treated are removed by cleaning or washing in advance of quenching, and the quenching oil adhering to the quenched articles is also removed in advance of tempering.

In a case of cleaning or washing the articles, organic solvents such as trichloroethylene, flon and so on and water soluble alkali washing agents such as caustic soda and so on are used. Furthermore, in precleaning of treatment accompanied with heating such as carburizing, a method of vaporizing the oils adhering to the articles by heating the articles in flames and burning the oils is also adopted. In addition to above, a method and an apparatus for removing oils adhering to articles by reducing pressure in a sealed chamber contained with the articles or by reducing the pressure in the sealed chamber and heating the anticles in the sealed chamber are disclosed in japanese Patent Disclosure (KOKAI) No. 60-71077.

However, in the cleaning or washing using the organic solvents among the above-mentioned conventional removing method-of oils, although the organic solvents have very powerful effect of washing or rinsing out the oils, it is necessary to pay always attention to ventilation and recoveny of vapor of the solvents since the solvents are expensive and harmful to human body and environment. Furthermore, it is not possible to wash the articles heated at a high temperature since the solvents evaporate, and it is necessary to cool the articles even in a case of tempering the articles after the washing. Therefore, the thermal loss is serious. Especially, in a case of flon, trichloroethan and the like, production and consumption will be controlled and forbidden legally in the near future because of the destruction of the ozonesphere.

On the other side, although the alkali washing agents are not so expensive, the agents are not so effective to wash out the oils from the articles as compared with the above-mentioned arganic solvents, there are problems in that the alkali washing agents remain on the surfaces of trays and basckets after a long period of time, it is difficult to separate oils from the agents, and there is another problem of draining treatment.

As to the method for removing oils from the articles by burning the oils in flames, it is possible to utilize the temperature of the articles heated at about 400°C in order to burn the oils as preheating of carburizing to be carry out after removing the oils adhering to the articles, and the thermal loss is not so serious. However, there are problems in that it is merely possible to apply the method for pre-cleaning of the heat treatment, oxidation proceeds on surfaces of the articles and the time required for carburizing becomes longer when the articles are heated at a high temperature, and the oils are not removed completely and cause sooting when the articles are merely heated at a temperature not so high.

The vaporizing method disclosed in the Japanese Patent Disclosure No. 60-71077 is investigated for the purpose of solving the problems of the aforementioned washing or removing method, therefore it is an excellent method for removing oils from the articles because the solvents and the agents harmful to human body and environment are not used and the thermal loss is slight. However, the cutting oil, the antitarnish oil, the quenching oil and so on are generally synthetic oils composed of some of different kinds of oils and contains various additions such as an interfacial active agent, an inhibitor. Accordingly, in the vaporizing method, the additions of this kind and a part of the oils are pyrolyzed into gases impossible to be recovering by a condenser, the gases remain in the sealed chamber and circulation paths. Therefore, there is a problem in that the pyrolyzed gases are discharged in the air through a vacuum pump when the sealed chamber is evacuated at the last step of removing the oils, and an offensive odor spreads in the neighborhood.

The present invention is made in view of the aforementioned problems of the prior arts, it is an object to provide a method and an apparatus for removing oil from an article which are possible to remove oil such as cutting oil, antitarnish oil, quenching oil or the like adhering to a surface of the article in short time without using harmful substances and flames, and which does not discharge gas impossible to be recovered by condensation such as pyrolyzed gas of additions contained in the oils and does not spread an offensive odor in the air.

The construction of the method for removing oil from an article according to this invention for attaining the aforementioned object is characterized by comprising the steps of charging the article attached with the oil into a sealed chamber, replacing an atmosphere in the sealed chamber with replacer gas selected from non-oxidative gas and slightly oxidative gas, heating the article housed in the sealed chamber, exhausting the replacer gas and burning the oil evaporated from the article and a burnable component contained in said replacer gas, and evacuating the sealed chamber and exhausting the replacer gas through oil trapping means. The construction of the method for removing oil from an article according to another aspect of the invention is characterized by recovering the oil evaporated from the article and contained in the replacer gas at a condenser and burning only a

burnable component impossible to be condensed at the condenser and contained in said replacer gas.

In the other aspects of the method for removing the oil from the article according to this invention, it is preferable to rinse the article preliminarily in advance of being charged into the sealed chamber, and desirable to heat the article by a radiant tube burner using gas as fuel.

The construction of the apparatus for removing oil from an article according to this invention for attaining the aforementioned object is characterized by comprising a sealed chamber for housing the article attached with the oil, evacuation means for exhausting the sealed chamber, gas feeding means connected with the sealed chamber for supplying replacer gas into the sealed chamber and replacing and atmosphere in the sealed chamber with the replacer gas, heating means disposed in said sealed chamber for heating the article housed in the sealed chamber, burning means connected with the sealed chamber for burning the oil evaporated from the article and a burnable component contained in said replacer gas, and oil trapping means connected with the evacuating means for catching the oil and other components slightly remainding in said replacer gas. The construction of the apparatus for removing oil from an article according to another aspect of this invention is characterized by comprising the aforementioned sealed chamber, the evacuation means, the gas feeding means, the heating means, the oil trapping means, and further comprising condenser means communicating with the sealed chamber for recovering the oil evaporated from the article by condensing the evaporated oil contained in the replacer gas and burning means connected with the sealed chamber through the condenser means for burning a burnable component impossible to be condensed by the condenser means and contained in the replacer gas.

In the other aspects of the apparatus for removing the oil from the article according to this invention, it is preferable that the heating means is a radiant tube burner provided with a main burner nozzle and a sub-burner nozzle for using gas as fuel, and desirable that the apparatus is further provided with a washer for rinsing the article preliminarily with a solvent having a low boiling point in advance of charging the article into the sealed chamber.

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings, in which:-

Figure 1 is a distribution diagram illustrating the apparatus for removing the oil from the article according to an embodiment of this invention; and

Figure 2 is a distribution diagram illustrating an example of the washer for rinsing the article preliminarily used in the method for removing the oil from the article according to this invention.

In the method for removing oil from an article according to this invention, the sealed chamber charged with the article or articles is evacuated and replaced with replacer gas; that is non-oxidative gas or slightly oxidative gas and the articles are heated in the sealed chamber. The replacer gas introduced in the sealed chamber is circulated between the sealed chamber and the condenser disposed on the outside of the sealed chamber and oils evaporated from the surfaces of the articles by heating and contained in the replacer gas are recovered by condensation at the condenser. And the burnable components impossible to be recovered by the condensation such as additions contained in the cutting oil, antitarnish oil, quenching oil and so on, pyrolyzed gases of a part of the oils and the like are burned completely.

In this time, it is possible to select the replacer gas between the non-oxidative gas such as argon and nitrogen and the slightly oxidative gas such as DX gas for replacing the atmosphere in the sealed chamber according to a kind of the oil to be removed and the treatment applied on the articles at the subsequent process.

Namely, as replacer gas to be in contact with the articles at a high temperature, it is necessary to use the non-oxidative gas in a case required for bright cooling such as a case of oil removing after quenching. However, excepting such a case, there is almost no recognizable influence upon the quality of the articles and the subsequent process even if the low-priced DX gas is used, and oils with high boiling point contained in the cutting oil or the quenching oil never stick on the surfaces of the articles by scorching since the oils are removed by oxidation. Therefore, it is possible to reduce the cost of removing the oil remarkably by using the slightly oxidative gas such as the DX gas because preliminary washing of the articles using solvent can be omitted even when the high boiling point oils are contained in the oil adhering to the articles.

According to the composition of the oil adhering to the articles and a kind of gas used for replacing the atmosphere in the sealed chamber, the oil contained in the replacer gas may be burned together with the burnable components impossible to be recovered without recovering the oil by the condensation. Such the method is performed in a case in which the replacer gas is not so expensive like the DX gas and the oil adhering to the articles are not worth to be used, for example. In this time, the oil and the burnable components such as pyrolyzed gas are burned completely, therefore the offensive odor never spreads in the neighborhood.

In a case of applying the method according to this invention as a pre-treatment of gas nitriding or gas soft nitriding, it is possible to activate the nitriding by introducing oxidative gas represented by air and oxidizing the surfaces of the articles slighty after removing the oil from the articles at a temperature of

about 400°C on basis of the aforementioned method.

In a case in which the articles can not be heated at a high temperature because of the quality and characteristics of the article or a case in which the cutting oil or quenching oil adhering to the articles containes oils hard to vaporize because of their high boiling points, and the slightly oxidative gas can not be applied as the replacer because of the treatment applied on the articles at the subsequent process, it is preferable to remove the oil at a comparative low temperature (100-200°C) or in an atmosphere of the non-oxidative gas according to demand after rinsing the articles with a solvent having a low boiling point and moving the articles into the sealed chamber.

In this case, it is preferable to use the solvent not so dangerous as an inflammable and not so stringent in legal control as a dangerous article under the fire laws, and it is desirable to use the solvent of which flashing temperature is not lower than 70°C.

The apparatus for removing the oil from the article according to this invention comprises the sealed chamber, the evacuation means, the gas feeding means, the heating means, the burning means, the oil trapping means, and the condenser means as occasion demands. Among them, concerning the heating means, although an electric heater may be used without hinderance, it is desirable to use radiant tube burner using LP gas (propane), butane and natural gas as fuel in order to improve the heating rate and shorten the time required for removing the oil from the articles. Furthermore, as to the gas feeding means, it may be designed so as to supply the most adequate gas into the sealed chamber selectively between the non-oxidative gas, the slightly oxidative gas and the oxidative gas according to a kind of oils to be removed, the characteristics of the articles and the treatment applied on the articles at the subsequent process.

In the method and apparatus according to this invention for removing the oil from the article, a main component of the oil such as cutting oil, antitarnish oil, quenching oil or the like is vaporized by heating the article in the replacer gas, and the oil adhering to the article is separated and removed from the article by circulating the vapor of the oil together with the replacer gas and recovering the oil at the condenser disposed in the middle way of the circulation path or by burning the vapor of the oil without recovering.

On the other side, the high boiling point oils contained in the oil adhering to the article are designed so as to be rinsed out by washing the article preliminarily or to be removed by being oxidized with the slightly oxidative gas selected as the replacer gas according to the characteristics of the article and the treatment to be applied on the article at the subsequent process.

The burnable components impossible to be recovered by the condensation at the condenser such as additions contained in the oil adhering to the article and the pyrolized gas of a part of the adhering oil are burned completely together with or after recovering the oil evaporated from the article. Accordingly, the additions and the pyrolized gas are never discharged in the air and never caused an offensive odor in the neighborhood.

An embodiment of the method and apparatus according to this invention for removing the oil from the article will be described below concretely on basis of Figures 1. and 2.

Figure 1 shows an embodiment of the apparatus used for the method according to this invention in order to remove the oil from the article, the apparatus shown in the figure comprises a sealed chamber 3 having a closed space 2 for charging an article 1, a radiant tube burner 4 as a heating means for heating the article 1 in the closed space 2, a vacuum pump 5 as an evacuation means for exhausting the closed space 2 of the sealed chamber 3, a gas feeding pipe 6 as a gas feeding means for supplying replacer gas selected from non-oxidative gas, slightly oxidative gas and oxidative gas into the closed space 2 of the sealed chamber 3, a condenser 7 as a condenser means communicating with the closed space 2 of the sealed chamber 3 for condensing oil evaporated and separated from the article 1, a burner 8 as a burning means for burning burnable components such as pyrolized gas impossible to be condensed by the condenser 7, and an oil mist trap 16 as an oil trapping means connected with the vacuum pump 5 for catching the oil and other components slightly contained in the replacer gas.

The sealed chamber 3 is formed with the closed space 2 by disposing a front door 11 lined with a heat insulator 10 on the left side of a chamber body lined similarly with a heat insulator 9 as shown in Figure 1. The sealed chamber 3 is provided with a fan 12 for making the temperature in the closed space 2 uniform by stirring an atmosphere in addition to the radiant tube burner 4 for heating the atmosphere in the closed space 2 on the upper side thereof.

The condenser 7 communicates with the closed space 2 of the sealed chamber 3 through a pipe 13, and is connected with the vacuum pump 5 through a pipe 14 and a valve 15. The vacuum pump 5 is disposed with an exhaust pipe 17 through the oil mist trap 16.

The gas feeding pipe 6 is connected to a nitrogen cylinder, a DX gas generator and outside air (which are not shown) respectively, and so disigned as to supply into the closed space 2 with nitrogen (non-oxidative gas), DX gas (slightly oxidative gas) and (oxidative gas) selectively.

The pipe 14 is connected with a pipe 20 attached with a valve 19, which is connected with a blower 21 at another end thereof. The blower 21 is connected with a pipe 24 disposed with a valve 22 and a pres-

sure gauge 23 at the middle part, the pipe 24 communicates with the closed space 2 of the sealed chamber 3 at the opposite end thereof.

A pipe 25 branches off from the pipe 20 at the position between the valve 19 and the blower 21, and connected to the burner 8 through a valve 26.

Next, explanation will be given about the procedure for removing the oil from the article 1 using the apparatus having the aforementioned structure.

First of all, the front door 11 is opened and the article 1 is charged into the sealed chamber 3, then the door 11 is closed. And pressure in the closed space 2 of the sealed chamber 3 is reduced into 100-10000 Pa by actuating the vacuum pump 5 after closing the valves 18, 19 and 22, and opening the valve 15.

Subsequently, nitrogen or DX gas is supplied into the closed space 2 through the gas feeding pipe 6 according to a kind of the article 1 and the treatment applied on the article at the subsequent process by opening the valve 18 and the atmosphere of the closed space 2 of the sealed chamber 3 is replaced with either gas. In this time, it is possible to omit the preliminary washing of the article 1 by using the DX gas, which is slightly oxidative gas even when the high boiling point oils are contained in the cutting oil or the quenching oil adhering to the article 1, and it is desirable from a viewpoint of cost excepting a case in which the bright cooling is requied, that is a case of oil removing combined with tempering performed after oil quenching, for example.

Next, the temperature of the atmosphere in the closed space 2 is raised up to the predetermined temperature by the radiant tube burner 4 as stirring the atmosphere by the fan 12 after closing the valves 15 and 18. In the radiant tube burner 4 in this embodiment, butane gas is used as fuel and it is possible to raise the temperature very quickly.

During the temperature rising, the replacer gas in the closed space 2 of the sealed chamber 3 is circulated through a path of the pipe 13, the condenser 7, the pipes 20 and 24 by actuating the blower 21, after opening the valves 19 and 22, and the oil evaporated from the article 1 and contained in the replacer gas is recovered by condensing the evaporated oil at the condenser 7.

In this time, the additions such as an interfacial active agent contained in the cutting oil or quenching oil adhering to the article 1 and the pyrolized gas of a part of the oil continue circulating in the aforementioned circulation path and the closed space 2 of the sealed chamber 3 because they are not impossible to be condensed at the condenser 7. The other side, the replacer gas circulating in the circulation path and the closed space 2 expands with the temperature rise, therefore the replacer gas corresponding to the expanding amount is discharged by opening the valve 26. And burnable components such as the pyrolized gas contained in the discharged replacer gas are introduced to the burner 8, turned into odorless exhaust gas as a result of complete burning at the burner 8 and exhausted.

In a case of using the DX gas as the replacer gas, the high boiling point oils contained in the cutting oil or the quenching oil adhering to the article 1 do not remain on the surface of the article 1 since they are oxidized by $CO_2$ contained in the DX gas and removed. The gas generated by oxidation is not possible to be recovered by the condenser 7, therefore the gas is introduced into the burner 8 together with the pyrolized gas and exhausted after burning completely in the same manner as a burnable component.

In a case the oil adhering to the article 1 and the replacer gas are not so expensive and the recovered oil does not have utility value, the vaporized oil may be also burned together with the burnable components such as the pyrolized gas at the burner 8 through a pipe (not shown) disposed between the burner 8 and the closed space 2 of the sealed chamber 3.

If the closed space 2 of the sealed chamber 3 attains the predetermined temperature, the gas exhausted to the burner 8 disappears and the oil becomes not to be further recovered through the condenser 7, the closed space 2 is evacuated and the replacer gas in the closed space 2 is exhausted through the exhaust pipe 17 by closing the valves 19 and 22, opening the valve 15 and actuating the vacuum pump 5. In this time, even if the vaporized oil and the pyrolized gas are contained more or less in the replacer gas, they are never exhaust in the air since the evaporated oil is recovered at the condenser 7 and the gas impossible to be recovered such as the pyrolized gas are caught by the oil mist trap 16.

The oil remainding on the surface of the article 1 in a case of using the non-oxidative nitrogen as a replacer gas is evaporated by reducing the pressure in the closed space 2 through the vacuum pump 5 and recovered by the condensation at the condenser 7 for the most part excepting the high boiling point oils.

In such a manner, the removing of the oil is completed, the closed space 2 of the sealed chamber 3 is brought back to the atmospheric pressure by opening the valve 18 and supplying the DX gas the same as the replacer gas through the gas feeding pipe 6 in the case of oil removing before quenching. Subsequently, the front door 11 is opened, the article 1 is taken out of the sealed chamber 3 and sent to the subsequent process of quenching. In this case, it is possible to utilize the remainding heat of the oil removing as preheating for the quenching.

For example, the bright cooling is required down to 150 °C in the case of oil removing combined with tempering, accordingly the closed space 2 is brought back to the atmospheric pressure by supplying the nitrogen which is the same as the replacer gas and the article 1 is cooled by circulating the atmosphere with

a blower 21 after closing the valves 18 and 15 and opening the valves 19 and 22. Then the door 11 is opened and the article 1 is taken out of the sealed chamber 3 after the article 1 is cooled at a temperature lower than 150°C.

Furthermore, it is preferable to oxidize the surface of the article 1 slightly and to improve the nitriding efficiency according to demand by introducing air from the gas feeding pipe 6 through the valve 18 in the case of removing the oil performed as pre-treatment for the gas nitriding and the gas soft nitriding.

In the case in which the oil having high boiling point and hard to vaporize is tried to be removed from the article 1 without using the slightly oxidative gas considering the treatment to be applied on the article 1 at the subsequent process and the case in which the oil removing can not be carried out at elevated temperatures in order to prevent the quality of the article 1 from the bad influence caused by the heat (namely, in the case the quenchingt oil has high boiling point and is hard to be evaporated and the tempering temperature is not so high, for example), it is preferable to rinse out the oil by the preliminary washing using the solvent with a low boiling point, and desirable to vaporize the solvent at a temperature of 100-200°C.

Figure 2 shows an example of the washer used for such the preliminary washing, the preliminary washer shown in the figure is provided with some spray nozzles 31 on the upper inner side of a washer body 30, installed with a dipping bath 32 contained with a washing oil having a low boiling point on the lower part thereof, and so designed as to move the article 1 up and down by an elevator 33. Additionally, it is preferable to use the washing oil not so dangerous as a inflammable and not so stringent in legal control as a dangerous article under the fire laws, that is washing oil of which flashing temperature is not lower than 70°C. In this example, the washing oil of which flashing temperature is 111 °C is used.

The dipping bath 32 is connected with a distiller 36 through a pipe 35 having a valve 34, and the distiller 36 are provided with a drain oil pipe 38 in addition to a heater 36. The distiller 36 are connected to a condenser 40 at the upper part thereof through a pipe 39, and the condenser 40 is connected to the distiller 36 and a washing oil tank 42 through a pipe 41. Furthermore, the washing oil tank 42 is connected to a shower pump 43, which is connected to the spray nozzles 31 disposed on the upper inner side of the washer body 30 through a pipe 44 and valves 45.

Explanation will be given below about the procedure for using the preliminary washer.

First, the article 1 is charged into the elevator 33 of the washer body 30 and dipped into the washing oil in the dipping bath 32 by working the elevator 33. In this time, it is possible to improve the washing efficiency by moving the elevator 33 up and down several times.

After the dipping, the elevator 33 is lifted up and the shower pump 43 is actuated. Whereby the oil adhering to the article 1 is rinsed out by spraying the washing oil in the washing oil tank 42 toward the article 1 for predetermined time through the spray nozzles 31 after regulating the flow rate by the respective valves 45. Then, the article 1 is taken out from the elevator 33 after leaving the article 1 for 5-10 minutes and making the oil in drops, and charged into the sealed chamber 3 of the apparatus shown in Figure 1.

The oil which has a high boiling point and is hard to vaporize in the washing oil in the dipping bath 32 concentrates gradually with the repetition of such the preliminary washing, therefore the washer is so disigned as to feed the washing oil into the distiller 36 from the dipping bath 32 as much as predetermined volume through the valve 34 and distill the washing oil from the high boiling oil by heating with the heater 37. The distilled washing oil is recovered into the washing oil tank 42.

In such a manner, in the apparatus for removing the oil from the article 1 according to this embodiment, it is possible to supply into the closed space 2 of the sealed chamber 3 with the non-oxidative gas, the slightly oxidative gas and the oxidative gas selectively. Accordingly, the apparatus is so structured as to adopt the most effective and economical method for removing the oil from the article 1 by selecting freely a kind of the replacer gas, practice of the preliminary washing, the recovery of the oil and the surface oxidation of the article 1 considering the oil to be removed, characteristics of the articles 1 and the treatment performed at the subsequent process.

As mentioned above, in the method and apparatus for removing the oil from the article according to this invention, it is possible to remove the cutting oil, the antitarnish oil or the quenching oil adhering to the article together with the high boiling point oils and the various additions contained in the oils, to say nothing of the main component of the oils smoothly, efficiently and economically by heating the article in the replacer gas selected according to the properties of the article and the treatment to be applied on the article at the subsequent process. Furthermore, an excellent effect can be obtained in that the offensive odor never spreads in the neighborhood because the burnable components such as the high boiling point oils and the pyrolized gas of the additions which are impossible to be condensed are exhausted after burning completely.

## Claims

1. A method for removing oil adhering to an article which comprises the steps of:

charging the article attached with the oil into a sealed chamber;

replacing an atmosphere in the sealed chamber with replacer gas selected from non-oxidative gas and slightly oxidative gas;

heating the article housed in said sealed chamber;

exhausting the replacer gas and burning the oil evaporated from the article and a burnable component contained in said replacer gas; and

evacuating the sealed chamber and exhausting the replacer gas through oil trapping means.

2. A method for removing oil adhering to an article which comprises the steps of:

charging the article attached with the oil into a sealed chamber;

replacing an atmosphere in the sealed chamber with replacer gas selected from non-oxidative gas and slightly oxidative gas;

heating the article housed in said sealed chamber;

circulating the replacer gas between the sealed chamber and a condenser;

recovering the oil evaporated from the article and contained in the replacer gas by condensing the evaporated oil at the condenser and burning a burnable component impossible to be condensed by said condenser and contained in said replacer gas; and

evacuating the sealed chamber and exhausting the replacer gas through oil trapping means.

3. A method for removing oil adhering to an article as set forth in claim 1 or 2, wherein said article is charged into the sealed chamber after being rinsed preliminarily with a solvent having a low boiling point.

4. A method for removing oil adhering to an article as set forth in claim 3, wherein said article is heated by a radiant tube burner using gas as fuel.

5. A method for removing oil adhering to an article as set forth in claim 4, wherein said article is heated at a temperature in a range of 100-200°C.

6. A method for removing oil adhering to an article as set forth in claim 5, wherein said solvent have flashing temperature not lower than 70°C.

7. An apparatus for removing oil adhering to an article comprising:

a sealed chamber for housing the article attached with the oil;

evacuation means for exhausting said sealed chamber;

gas feeding means connected with said sealed chamber for supplying replacer gas into the sealed chamber and replacing an atmosphere in the sealed chamber with the replacer gas;

heating means disposed in said sealed chamber for heating the article housed in the sealed chamber;

burning means connected with said sealed chamber for burning the oil evaporated from the article and a burnable component contained in said replacer gas; and

oil trapping means connected with said evacuation means for catching the oil and other components slightly remainding in said replacer gas.

8. An apparatus for removing oil adhering to an article comprising:

a sealed chamber for hausing the article attached with the oil;

evacuation means for exhausting said sealed chamber;

gas feeding means connected with said sealed chamber for supplying replacer gas into the sealed chamber and replacing an atmosphere in the sealed chamber with the replacer gas;

heating means disposed in said sealed chamber for heating the article housed in the sealed chamber;

condenser means communicating with said sealed chamber for recovering the oil evaporated from the article by condensing the evaporated oil contained in said replacer gas;

buring means connected with said sealed chamber through said condenser means for burning a burnable component impossible to be condensed by said condenser means and contained in said replacer gas; and

oil trapping means connected with said evacuation means for catching the oil and other components slightly remainding in said replacer gas.

9. An apparatus for removing oil adhering to an article as set forth in claim 7 or 8, wherein said heating means is a radiant tube burner provided with a main burner nozzle and a sub-burner nozzle for using gas as fuel.

10. An apparatus for removing oil adhering to an article as set forth in claim 9, wherein said apparatus is further provided with a washer for rinsing the article preliminarily with a solvent having a low boiling point in advance of charging the article into said sealed chamber.

FIG.1

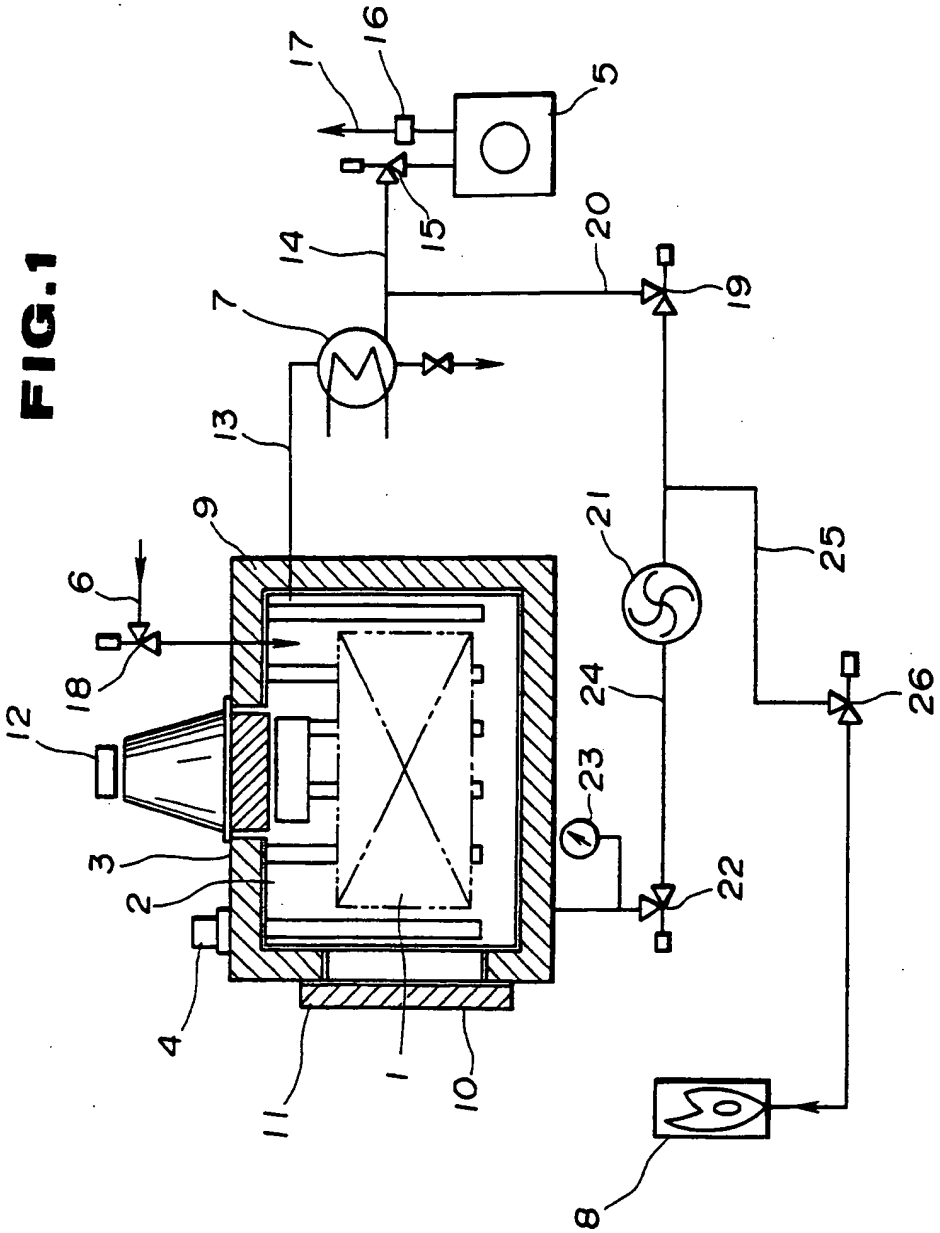
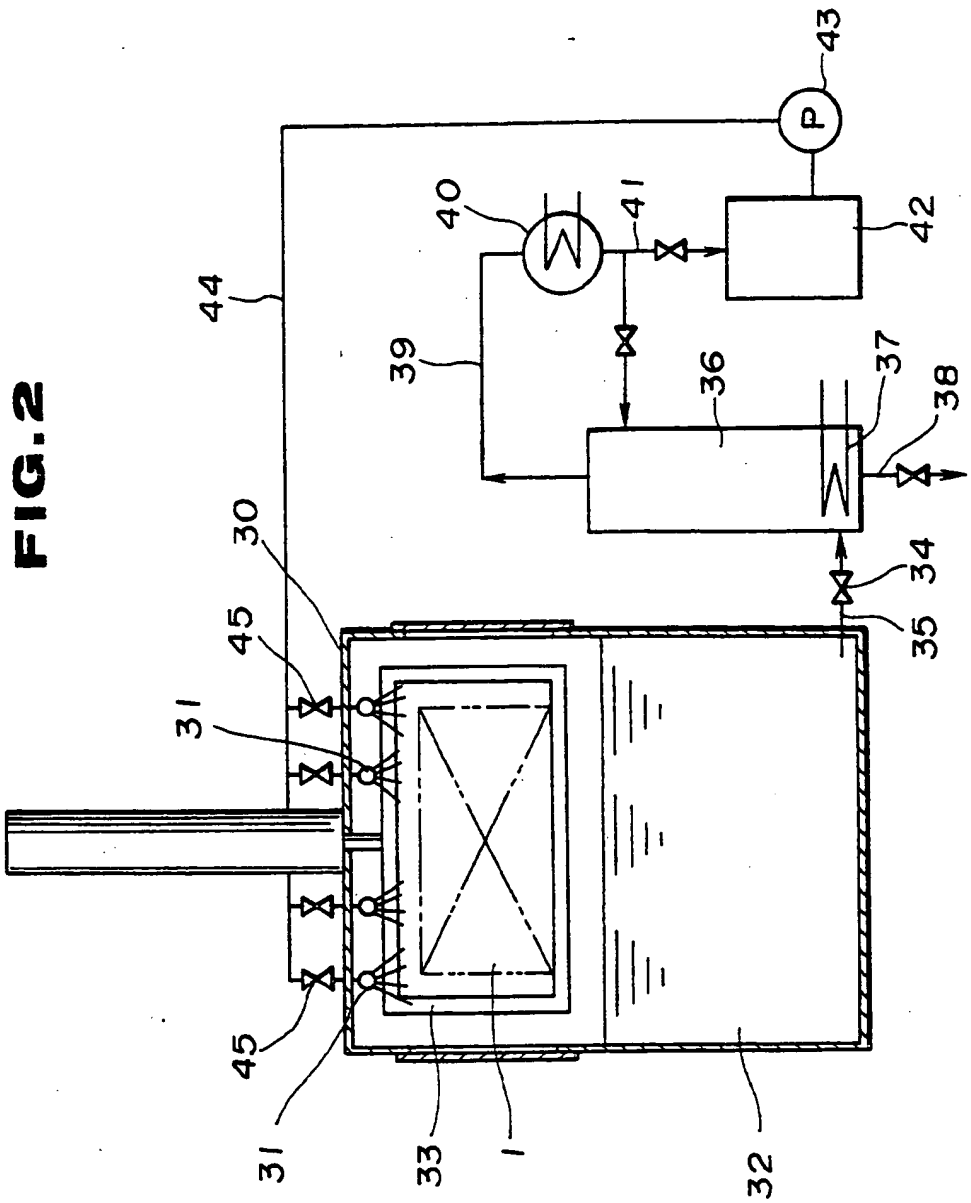


FIG.2



European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 93 30 0500

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
|---|---|---|---|
| X<br>A | US-A-4 141 373 (KARTANSON)<br>27 February 1979<br>* column 1, line 64 - column 2, line 48; figures 1,2 *<br>* column 3, line 1 - line 6 *<br>* column 4, line 20 - column 5, line 35 *<br>* column 6, line 18 - line 27 * | 1,2,5,7,8<br>3,4,6,9,10 | C23G5/00 |
| P,A | US-A-5 137 581 (TAKAHASHI)<br>11 August 1992<br>* column 3, line 65 - column 4, line 32; figure 1 *<br>* column 6, line 6 - line 11 * | 1,2,7,8 | |
| D,A | JP-A-60 071 077 (...)<br>22 April 1985 | | |

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

C23G
B08B

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 06 MAY 1993 | VOLLERING J.P.G. |

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